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Faciomaxillary trauma an update



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ABSTRACT

This supplement of otolaryngology online journal covers the topic of Faciomaxillary trauma. Topics covered include fractures involving nasal bones, zygoma, maxilla and frontal bones. The entire discussion is from the perspective of otolaryngologist.

Balasubramanian Thiagarajan

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This journal will contain peer reviewed publications in the field of otolaryngology. The contents will be arranged under the following subcategories:

1. Article (peer reviewed)
2. Interesting case record (Peer reviewed)
3. Personal communication
4. Book reviews
5. Review article
6. Radiology image of the issue

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Contents

1. [Fracture nasal bones](#)
2. [Fracture zygoma and its management our experience](#)
3. [Blow out fracture a novel management modality](#)
4. ['old Foley's in a new bottle'- USE OF FOLEY'S CATHETER IN ANTERIOR MAXILLARY WALL FRACTURES](#)
5. [Fracture frontal bone and its management](#)



Fracture Nasal Bones

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Abstract:

Nose is the most prominent part of the face, hence it is likely to be the most common structure to be injured in the face. Although fractures involving the nasal bones are very common, it is often ignored by the patient. Patients with fractures of nasal bone will have deformity, tenderness, haemorrhage, edema, ecchymosis, instability, and crepitation. These features may be present in varying combinations. This article discusses the pathophysiology of these fractures, role of radiography and ultrasound in their diagnosis and their management.

Introduction:

Nasal bone fractures are common because:

1. Nose happens to be the most prominent portion of the face
2. Increasing number of road traffic accidents¹
3. Increasing incidence of domestic violence²
4. Increase in the number of individuals taking part in contact sports³

Anatomy:

Nasal bones are paired bones. Both these bones project like a tent on the frontal process of maxilla. In the midline they articulate with one another. Just under this midline articulation lies the nasal septum. Superiorly the nasal bones are thicker where it articulates with the nasal process of frontal bone. This area is relatively stable and firm. Nasal bone fractures commonly occur at the transition zone between the proximal thicker and distal thinner portions. This zone precisely corresponds to the lower third of the nasal bone area.

Fractures involving nasal bones if not properly and promptly treated leads to:

1. Nasal deformities
2. Intranasal dysfunction like nasal block

Fracture nasal bone is known to cause higher incidence of morbidity and complications when compared that of fractures involving other facial bones ⁴. In order to treat this condition properly it is necessary to accurately diagnose this condition by:

1. Looking for crepitus and tenderness over the nasal bone area
2. Radiographic evaluation of nasal bones. Radiography helps in diagnosis and classification of nasal bone fractures, and also in checking the adequacy of reduction ⁵.

Clinicians are more interested in knowing:

1. Location of fracture site (like sidewall, dorsum, or the entire nasal bone)
 2. To know whether the fracture involves the right nasal bone / left nasal bone or both sides
 3. Whether there is any displacement of the fractured fragments (medial / lateral), presence of absence of comminution.
 4. To identify the presence of concurrent fractures to other facial bones / nasal septum.
- When there is the presence of fractures involving other facial bones / severe fractures of nasal septum it is prudent to perform open reduction.

Pathophysiology:

The following points should be borne in mind before attempting to understand the pathophysiological factors that lead to fractures involving nasal bones.

1. Nasal bones and underlying cartilage are susceptible for fracture because of their more prominent and central position in the face.
2. These structures are also pretty brittle and poorly withstands force of impact.
3. The ease with which the nose is broken may help protect the integrity of the neck, eyes, and brain. Thus it acts as a protective mechanism.
4. Nasal fractures occur in one of two main patterns- from a lateral impact or from a head-on impact. In lateral trauma, the nose is displaced away from the midline on the side of the injury, in head-on trauma, the nasal bones are pushed up and splayed so that the upper nose (bridge) appears broad, but the height of the nose is collapsed (saddle-nose deformity). In both cases, the septum is often fractured and displaced.
5. The nasal bone is composed of two parts: A thick superior portion and a thin inferior portion. The intercanthal line demarcates these two portions. Fractures commonly occur below this line.



Image of a patient with fracture nasal bone associated with deviation of dorsum of nose

6. Nasal bones undergo fracture in its lower portion and seldom the upper portion is involved in the fracture line. This is because the upper portions of the nasal bone is supported by its articulation with the frontal bone and frontal process of maxilla.

7. Because of the close association between nasal bone and the cartilaginous portions of the nose, and the nasal septum it is quite unusual for pure nasal bone fractures to occur without affecting these structures. If closed reduction alone is performed to reduce nasal bone fractures without correction of nasal septal fractures, this could cause progressive nasal obstruction due to uncorrected deviation of nasal septum. This is because of the tendency of the nasal septum to heal by fibrosis which causes bizarre deviations like "C" "S" etc. Since nose is the most prominent portion of the face, its supporting bony structures have low breaking strength the naso ethmoidal complex fractures when exposed to forces of about 80 grams. This fact was demonstrated by Swearingen in 1965.

Classification of nasal bone fractures:

Stranc Robertson classification ⁶:

Stranc and Robertson suggested that lateral forces accounted for the majority of nasal bone fractures. They also inferred that younger patients tend to have fracture dislocation involving large segments while older patients tended to have comminuted fractures. In 1978 Stranc and Robertson came out with their classification of nasal bone fracture based on the direction of impact and the associated damage. In this classification they also took into consideration the degree of damage to nasal bones and the nasal septum. This classification was based on the clinical examination of the nose and face. It did not take into account radiological findings.

Type I injury:

Fractures due to this type of injury does not extend behind the imaginary line drawn from the lower end of nasal bone to the anterior nasal spine. In this type of injury the brunt of the attack is borne by lower cartilaginous portion of the nasal cavity and the tip of the nasal bones. This type of injury may cause avulsion of upper lateral cartilages, and occasionally posterior dislocation of septal and alar cartilages.

Type II injury:

This type of injury involves the external nose, nasal septum and anterior nasal spine.

Patients with this type of injury manifest with gross deviations involving the dorsum of the nose including splaying of nasal bones, flattening of dorsum of nose and loss of central support of the nose.

Type III injury:

This injury involves orbit and intracranial structures.

Harrison's classification:

Fractures involving nasal bones are divided into three categories depending on the degree of damage, and its management. Class I fractures: Very little force is sufficient to cause a fracture of nasal bone. It has been estimated to be as little as 25-75 pounds / sq inch. Class I fractures are mostly depressed fractures of nasal bones. The fracture line runs parallel to the dorsum of the nose and naso maxillary suture and joins at a point where the nasal bone becomes thicker. This point is about 2/3 of the way along its length. The fractured segment usually regains its position because of its attachment along its lower border to the upper lateral cartilage. The nasal septum is not involved in this particular injury.

Class I fractures do not cause gross lateral displacement of nasal bones, though a persistent depressed fragment may give it the appearance. In children these fractures could be of green stick variety and a significant nasal deformity may develop subsequently during puberty when nasal growth accelerates. Clinically this fracture will present as a depression over the nasal bone area. There may be tenderness and crepitus over the affected nasal bone. Radiological evidence may or may not be present. In fact class I fracture of nasal bone is purely a clinical diagnosis.

Class II fractures: These fractures cause a significant amount of cosmetic deformity. In this group not only the nasal bones are fractured, the underlying fronto nasal process of the maxilla is also fractured. The fracture line also involves the nasal septum. This condition must be recognised clinically because for a successful result both the nasal bones as well as the septum will have to be reduced. Since both the nasal bones and the fronto nasal process of maxilla would have absorbed a considerable amount of force, the ethmoidal labyrinth and the adjacent orbit should be intact. The precise nature of the deformity depends on the direction of the blow sustained. A frontal impact may cause comminuted fracture of nasal bones causing gross flattening and widening of the dorsum of the nose. A lateral blow of similar magnitude is likely to produce a high deviation of the nasal skeleton. The perpendicular plate of ethmoid is invariably involved in these fractures, and is characteristically C shaped (Jarjaway fracture of nasal septum).

Class III fractures: Are the most severe nasal injuries encountered. This is caused by high velocity trauma. It is also known as naso orbital fracture / naso ethmoidal fracture. Recent term to describe this class (Naso orbito ethmoid fracture) indicates the clinical importance of orbital component in these injuries. These fractures are always associated with Le Fort fracture of the upper face involving the maxilla also. In these fractures the nasal bone along with the buttressing fronto nasal process of maxilla fractures, telescoping into the ethmoidal labyrinth. Two types of naso ethmoidal fractures have been recognised:

Type I: In this group the anterior skull base, posterior wall of the frontal sinus and optic canal remain intact. The perpendicular plate of ethmoid is rotated and the quadrilateral cartilage is rotated backwards causing a pig snout deformity of the nose. The nose appears foreshortened with anterior facing nostrils. The space between the eyes increase (Telecanthus), the medial canthal ligament may be disrupted from the lacrimal crest.

Type II: Here the posterior wall of the frontal sinus is disrupted with multiple fractures involving the roof of ethmoid and orbit. Sphenoid and parasellar regions may sometimes be involved. Since the dura is adherent to the roof of ethmoid fractures in this region causes tear in the dura causing csf rhinorrhoea. Pneumocranium and cerebral herniation may complicate this type of injury.

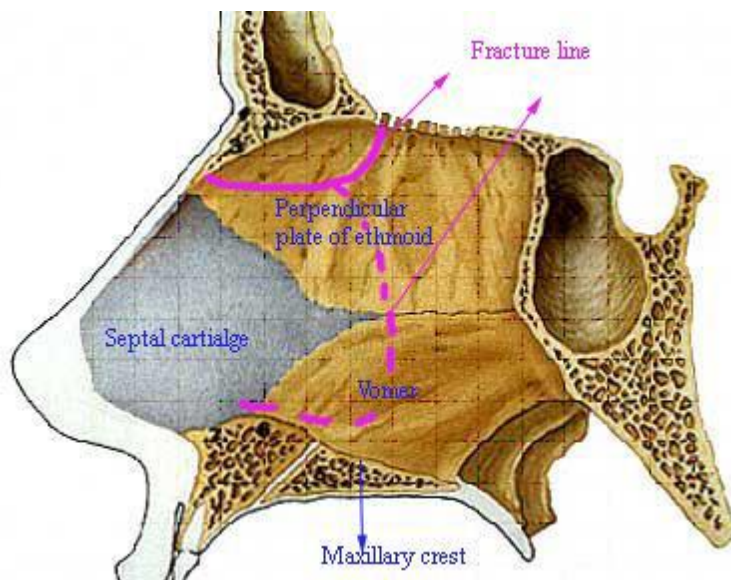


Figure showing the three types of nasal bone fractures

Murray's classification 7:

Murray et al after examining nearly 70 patients with fracture nasal bones classified them into 7 types. This classification was based on damage suffered by the nasal septum. This is actually a pathological classification.

Clinical pointers towards the diagnosis of fractures involving nasal bones:

1. Injuries involving middle third of face
2. History of bleeding from nose following injury
3. Oedema over dorsum of nose
4. Tenderness and crepitus over nasal bone area
5. Eyelid oedema
6. Subcutaneous emphysema involving eyelids
7. Periorbital ecchymosis

According to Sharp 8 X-rays of nasal bone fails to reveal fractures in nearly 50% of the patients.

Clinical examination:

This should include careful examination to rule out deformities involving nose and middle third of face. Clinical photograph of the patient should be taken in order to document the deformity. Patient should be quizzed regarding the presence of deformities in the area prior to injury. Acute injury photographs will help the surgeon to convince the patient that fracture reduction has been done in an appropriate manner. Studies reveal that nearly 30% of the patients⁹ are not satisfied with the post reduction outcome.

Radiology:

X-ray of nasal bone has very minimal role in the diagnosis of fractures involving the nasal bones. CT scan of nose and sinuses helps in identifying fractures involving other facial bones and in Lefort II and Lefort III fractures. Ultrasound using 10 MHz probe gives a clear view of the nasal bone area thereby facilitating easy identification of fractures. It also has the advantage of nil radiation hazard to the patient. Many images can be taken without any problem. It is also cost effective. According to Lee the accuracy of ultrasound in identifying fracture nasal bone was close to 100% while for conventional radiographs it was close to 70%.



Plain X-ray nasal bone revealing fracture line



Axial CT of nose and sinuses showing buckling of nasal septum due to fracture

Management:

If fractures of nasal bones are left uncorrected it could lead to loss of structural integrity and the soft tissue changes that follow may lead to both unfavourable appearance and function. The management of nasal fractures is based solely on the clinical assessment of function and appearance; therefore, a thorough physical examination of a decongested nose is paramount. Patients with fractures involving nose will have intense bleeding from nose making assessment a little difficult. Bleeding must first be controlled by nasal packing. These patients also have considerable amount of swelling involving the dorsum of the nose, making assessment difficult. These patients must be conservatively managed for at least 3 weeks for the oedema to subside to enable precise assessment of bony injury. According to Cummins Fracture reduction should be accomplished when accurate evaluation and manipulation of the mobile nasal bones can be performed; this is usually within 5-10 days in adults and 3-7 days in children ¹¹. Reduction is ideally performed immediately after injury before oedema sets in. If oedema has already set in it is prudent to wait for it to subside because it is difficult to ascertain adequacy of reduction in the presence of oedema ¹².

1. Closed reduction
2. Open reduction
3. Conservative management

Closed reduction:

This is the most preferred treatment modality in all acute phases of fractured nasal bones. Even if large deviations are seen closed reduction can be attempted prior to rhinoplasty as this would simplify the task of the plastic surgeon.

Indications for closed reduction according to Bailey:

1. Unilateral / Bilateral fracture of nasal bones
2. Fracture of nasal septal complex with nasal deviation of less than half of the width of the nasal bridge

Closed reduction can be performed under local / general anaesthesia. This decision should be made by the surgeon taking the patient into confidence. There is no difference in the results produced between surgeries performed under local anaesthesia and general anaesthesia ¹⁰. Patients seem to tolerate fracture reduction under local anaesthesia ¹⁴. Preoperative profile photograph of the patient is a must. This will give a general idea about adequacy of reduction.

Local anaesthesia:

This requires a thorough understanding of innervation of nose. Innervation of nose:

For effective administration of local anaesthesia a complete understanding of sensory innervation of nose and nasal cavity is a must. Innervation of nose can be divided into:

1. Innervation of mucosa within the nasal cavity
2. Innervation of external nose and its skin covering

Sensory innervation of external nose:

External nose and its skin lining is innervated by ophthalmic and maxillary divisions of trigeminal nerve.

Superior aspect of the nose is supplied by – Supratrochlear and Infratrochlear nerves (branches of trigeminal nerve) and external nasal branch of anterior ethmoidal nerve.

Inferior and lateral parts of the nose – is supplied by infraorbital nerve.

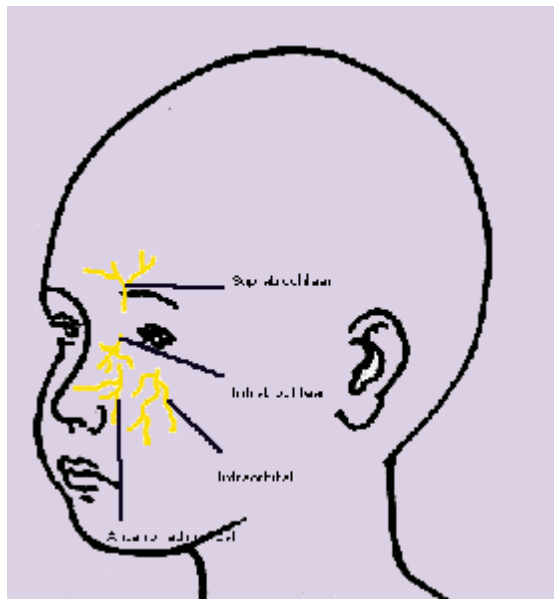


Figure showing sensory innervation of external nose

1. Superior inner aspect of the lateral nasal wall is supplied by anterior and posterior ethmoid nerves
2. Sphenopalatine ganglion present at the posterior end of middle turbinate innervates the posterior nasal cavity

3. Nasal septum is supplied by anterior and posterior ethmoidal nerves. Sphenopalatine ganglion also contributes to the sensory supply to the nasal septum via its nasopalatine branch.
4. Cribriform plate superiorly holds the olfactory special sensation fibers.

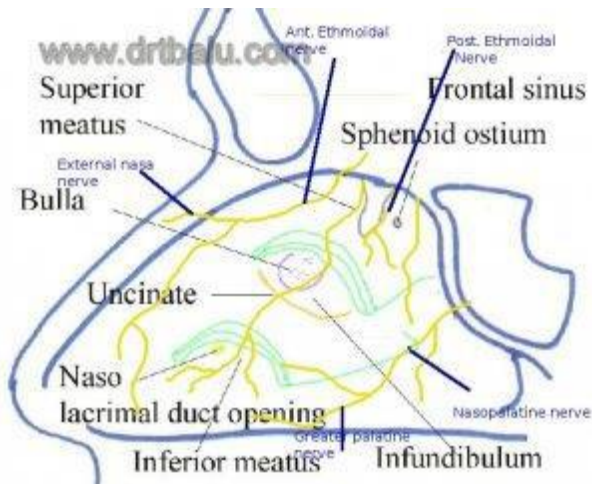


Figure showing sensory innervation of lateral nasal wall

Both topical and infiltrative anaesthesia is used for reduction of nasal bones. 4% xylocaine topical is used to pack the nasal cavity. 4% xylocaine mixed with 1 in 100000 adrenaline is used to pack the nasal cavity. This not only anaesthetizes the nasal cavity mucosa but also causes shrinking of the turbinates making instrumentation easier. Both nasal cavities are packed. The amount of 4% xylocaine used should not exceed 4 ml as the toxic dose is about 7 ml of 4% xylocaine. It must be borne in mind that 2% xylocaine is also going to be used as infiltration anaesthesia. One cotton pledget soaked in 4% xylocaine is inserted just under the upper lip and held in position for a couple of minutes.

Infiltration:

2% xylocaine is infiltrated in the following areas:

1. Through the intercartilagenous area over the nasal bones
2. Over the canine fossa

Most of class I fractures can be reduced by closed reduction and immobilization using Plaster of Paris cast. In majority of cases digital pressure alone is sufficient for the job.



Figure showing digital pressure being applied from the head end of the patient to reduce the fractured nasal bone

If the fractured fragments are impacted then a Welsham's forceps will have to be used to disimpact and reduce the fractured nasal bone. In the event of using Welsham's forceps to disimpact the nasal bone, there will be extensive trauma to the nasal mucosa causing epistaxis. The nasal cavity of these patients must be packed with roller gauze, with application of an external splint to stabilise the bone. In these patients it is also imperative to elevate the collapsed nasal septum using Ash forceps.



Figure showing Ash forceps being used to disimpact the nasal septum

After successful reduction the nasal cavity should be packed with antibiotic ointment impregnated gauze.

Open reduction:

Indications:

1. Extensive fractures associated with dislocation of the nasal bones and septum
2. Deviation of nasal pyramid of more than half of the width of the nasal bridge.
3. Fracture dislocation of caudal septum
4. Open fractures involving the nasal septum
5. Persistent nasal deformity even after meticulous closed reduction

Open reduction is preferred for all class III nasal bone fractures. The problem here is even though the nasal bones can be reduced the adjacent supporting bones (components of the ethmoidal labyrinth) do not support the nasal bones because of their brittleness. It is always better to reconstruct and stabilise the anterior table of the frontal bone so that other parts of nasal skeleton can derive support from it. Formerly transnasal wires were used to fix the nasal bones, but with the advent of plates and screws the whole scenario has undergone a dramatic change.

Ellis procedure of management of Class III fractures:

Aims of the procedure include:

1. Provision of adequate surgical exposure to provide an unobstructed view of all components of the fracture.
2. The medial canthal ligament should be identified. This is rarely avulsed and is usually attached to a large fragment of bone. Once identified the ligament should be reattached and secured to the lacrimal crest. This step will avoid the future development of telecanthus.
3. Reduction and reconstruction of medial orbital rim. This can be achieved by use of transnasal 26 gauge wires. If plates are used they should be very thin otherwise they will become conspicuous once the wound has healed.
4. Reconstruction of medial orbital wall and floor with bone grafts
5. Realignment of nasal septum
6. Augmentation of dorsum of the nose by the use of bone grafts
7. Accurate soft tissue readaptation should be encouraged by placing splints.

Complications of nasal bone fracture:

1. Cosmetic deformity (saddle nose, pig snout deformity). This is actually common in patients who have septal hematoma following injury to nasal bones.
2. Persistent septal deviation
3. CSF leak
4. Orbital oedema / complications
5. Nasal block / compromise of nasal functions

Nasal injuries in children:

Children's nose is mostly cartilaginous in nature containing small bones that are soft and more compliant more capable of absorbing forces due to injury. It is also a common fact that birth trauma could be the cause for septal deviations in these patients. Septal hematoma is more common in children¹³. In children it is better to avoid open reduction procedures and stick to closed manipulation techniques. Digital manipulation is the best technique. While attempting to perform digital reduction manipulation the surgeon should be aware that the feel of bone snapping back into place is not evident in children. Careful visual assessment of the shape of the nose is a must to ascertain adequacy of reduction.

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Fracture zygoma and its management our experience

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Abstract:

Zygoma is a very crucial component which maintains facial contour. Fractures involving zygoma is very common, in fact it is the second most common facial bone to be fractured following facial trauma (next only to nasal bones). Fractures involving maxilla not only creates cosmetic deformities, it also causes disruption of ocular and mandibular functions too. This article attempts to discuss in detail the etiopathogenesis and the various management options available. It also includes our 3 years' experience in treating these patients at Stanley Medical College Chennai.

During the period of 3 years between 2010 - 2012 about 82 patients got treated in our institution for Faciomaxillary trauma.

Introduction:

Zygoma plays a vital role in maintaining facial contour. This is because the facial contour is directly influenced by underlying bony architecture 1. Fracture and dislocation of this bone not only causes cosmetic defects but also disrupts ocular and mandibular functions too. The zygomatic region is a prominent portion of the face next only to the dorsum of the nose. This predisposes this bone to various trauma 2. The bony architecture of this bone is rather unique, it enables it to withstand blows with significant impact without being fractured. At the most it gets disarticulated along its suture lines. Fractures can involve any of the four articulations of zygoma which include zygomatico-maxillary complex, zygomatic complex proper, orbitozygomatic complex. Fractures involving zygoma should be repaired at the earliest because it can cause both functional and cosmetic defects.

Important functional defects involving this bone is restriction of mouth opening due to impingement on the coronoid process 3. It is hence mandatory to diagnose and treat this condition properly. It is also important to reduce this fracture and fix it accurately, because skeletal healing after inadequate reduction can cause reduced projection of malar region of the face leading on to cosmetic deformities. Accurate assessment of position of the fractured bone should be performed in relation to skull base posteriorly and midface

anteriorly. This assessment is very important before reduction is attempted to ensure accurate reduction of the fractured fragments.

Importance of facial buttresses in fracture of middle third of face ⁴:

The buttress system of midface is formed by strong frontal, maxillary, zygomatic and sphenoid bones and their attachments to one another. The central midface contains many fragile bones that could easily crumble when subjected to strong forces. These fragile bones are surrounded by thicker bones of the facial buttress system lending it some strength and stability.

Components of Buttress system:

For better understanding the components of the facial buttress system have been divided into:

1. Vertical buttresses
2. Horizontal buttresses

Vertical buttress:

These buttresses are very well developed.

They include:

1. Nasomaxillary
2. Zygomaticomaxillary
3. Pterygomaxillary
4. Vertical mandible

Majority of the forces absorbed by midface are masticatory in nature. Hence the vertical buttresses are well developed in humans.

Horizontal buttresses:

These buttresses interconnect and provide support for the vertical buttresses.

They include:

1. Frontal bar
2. Infraorbital rim & nasal bones
3. Hard palate & maxillary alveolus

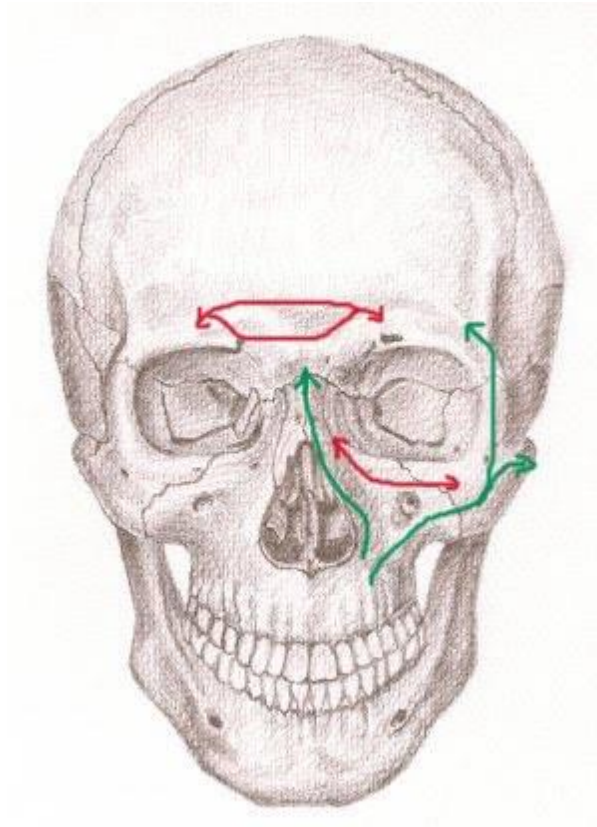


Diagram illustrating the Buttruss system of the facial skeleton

Incidence:

Among the 280 trauma patients admitted for treatment at Stanley Medical College 82 had sustained Faciomaxillary injuries.

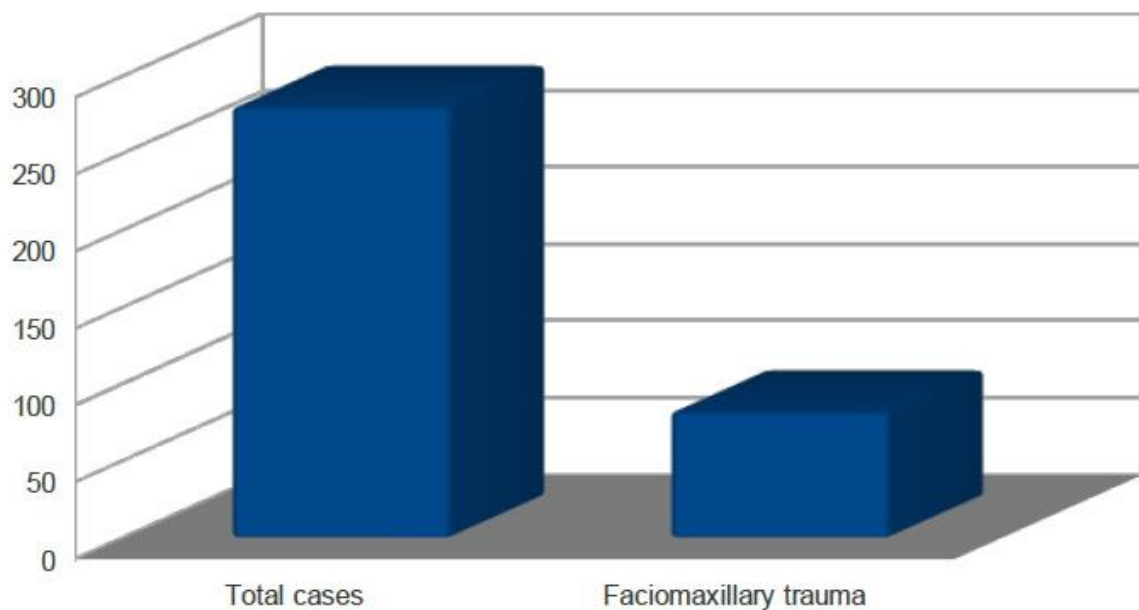


Chart showing the incidence of faciomaxillary trauma in comparison with other trauma cases

Among the cases studied 70 of them were males and the rest were females.

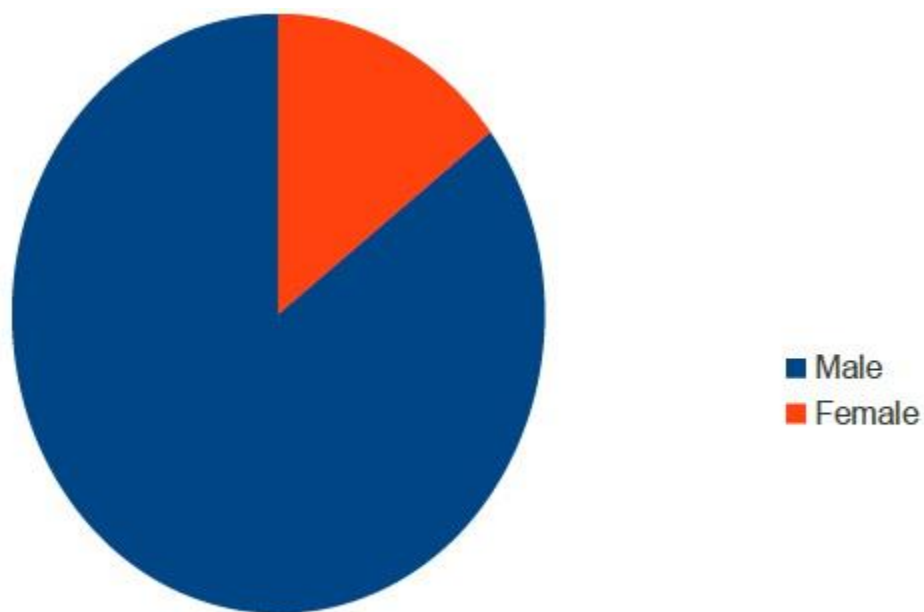


Chart showing the number of male and female patients who presented with fracture of zygoma

Classification of zygoma fracture:

Leefort classification:

1. Non displaced – Symptomatic treatment. No reduction necessary
2. Displaced – Closed reduction is necessary
3. Comminuted – Open reduction is necessary
4. Orbital wall fracture – If ocular symptoms predominate it should be attended first. After oedema subsides then open reduction can be attempted.
5. Zygomatic arch fracture – Open reduction with stabilization using micro plates / wiring.

Knight & North classification ⁵:

This classification suggested by Knight et al in 1961 helped to determine prognosis and optimal treatment modality for these individuals.

Group I fractures:

In these patients fracture lines in zygoma could be seen only in imaging. There is absolutely no displacement. These patients could ideally be managed conservatively by observation and by asking the patient to eat soft diet.

Group II fractures:

This group includes isolated fractures of the arch of zygoma. These patients present with trismus and cosmetic deformities.

Group III fractures:

This include unrotated fractures involving body of zygoma.

Group IV fractures:

This involves medially rotated fractures of body of zygoma.

Group V fractures:

This involves laterally rotated fractures of body of zygoma. This type of fracture is very unstable and cannot be managed by closed reduction. Open reduction will have to be resorted to.

Group VI fractures:

This is complex fracture. It has multiple fracture lines over the body of zygoma. This condition is difficult to manage by closed reduction. Open reduction and microplate fixation is indicated in these patients. This type of fracture should not be managed by closed reduction alone because the presence of oedema / haematoma would mask the cosmetic deformity giving an impression that reduction has occurred. After reduction of oedema and followed by the action of masseter the fractured fragment may distract making the cosmetic deformity well noticeable.

In our Institution patients with zygomatic bone fractures presented under various categories of Knight Classification. Majority of them belonged to Group I and II fractures.

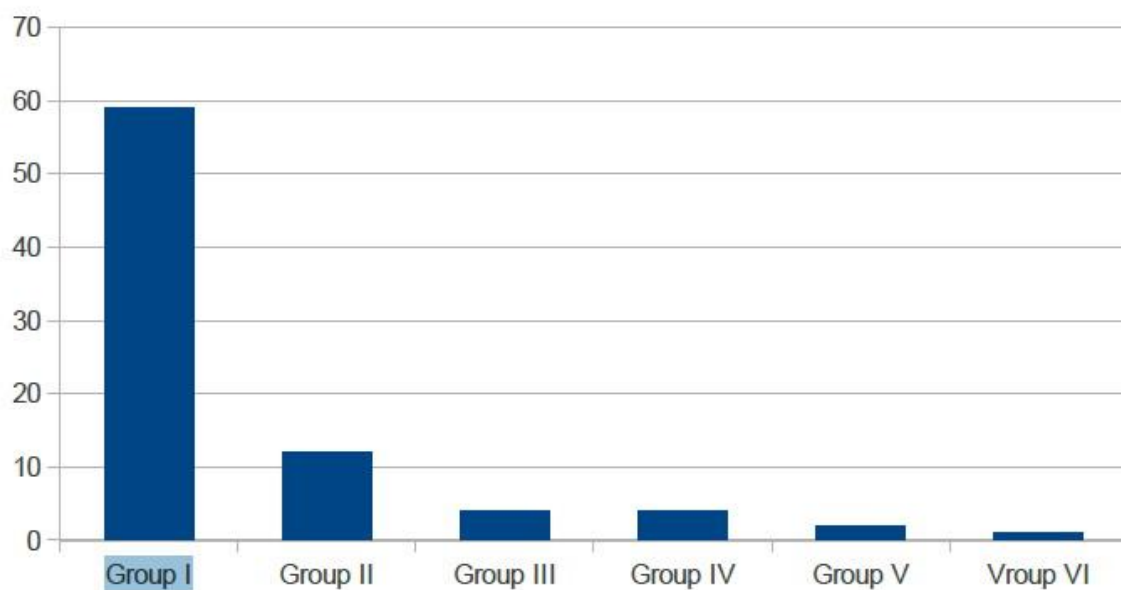


Table showing the number of patients in various groups of Knight's classification

Mason's classification of fracture zygoma:

Mason ⁶ et al used CT imaging to classify various forms of fracture zygoma. CT imaging provides the most accurate information about facial skeleton. Fractures involving facial bones, their positions, whether it is displaced or not can be clearly seen in CT scan images.

Mason classified fractures involving zygoma into:

1. Low energy injury
2. Medium energy injury
3. High energy injury

Low energy injury:

Low energy fractures involving zygoma involves minimal or no displacement of fractured fragments. In this group of patients fractures are commonly seen in the frontozygomatic suture line.

This area is very stable and hence fractures involving this area can be treated conservatively.

Middle energy injury:

Fracture zygoma due to middle energy injury causes fractures of all its supporting buttresses. There may be mild to moderate displacement and comminution. These patients invariably need eyelid / intraoral approach for adequate reduction and fixation of fracture.

High energy injury:

This injury frequently causes Lefort fractures. These patients have difficulty in opening their mouth. Repair of fractures involving this area should be carried out through multiple approaches which include:

Bicoronal approach

Intraoral approach

Eye lid approach

Studies reveal that primary bone healing allows quicker and stronger bone formation than callous healing ⁷. Rigid fixation of fractured fragments promote primary healing in preference to callous formation.

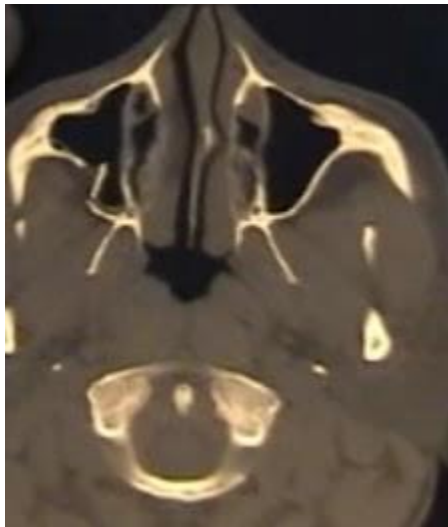
While performing open reduction it should be borne in mind that Titanium plates ⁸ are preferred to biodegradable ones when the process of reduction leaves small gaps between fractured fragments.

Clinical features:

1. Anaesthesia / Paraesthesia of that side of the face
2. Inability to open the mouth
3. Flattening of zygomatic area
4. Diplopia
5. Subconjunctival haemorrhage
6. Eye lid oedema
7. Periorbital haemorrhage
8. Lateral canthal dystopia

- 9. Ipsilateral epistaxis
- 10. Buccal sulcus haematomas
- 11. Enophthalmos in orbital floor fractures

Ophthalmic examination is a must if any of the ophthalmic manifestations of fracture of zygoma is seen. In the presence of ruptured globe, retinal detachment and traumatic optic nerve atrophy management of ophthalmic manifestations take precedence over fracture reduction procedure.



Axial CT image of nose and sinuses showing fracture of zygoma with medial displacement (stable)



Picture showing depressed fracture of zygoma (medial displacement)



Picture showing reduction being performed via intraoral route

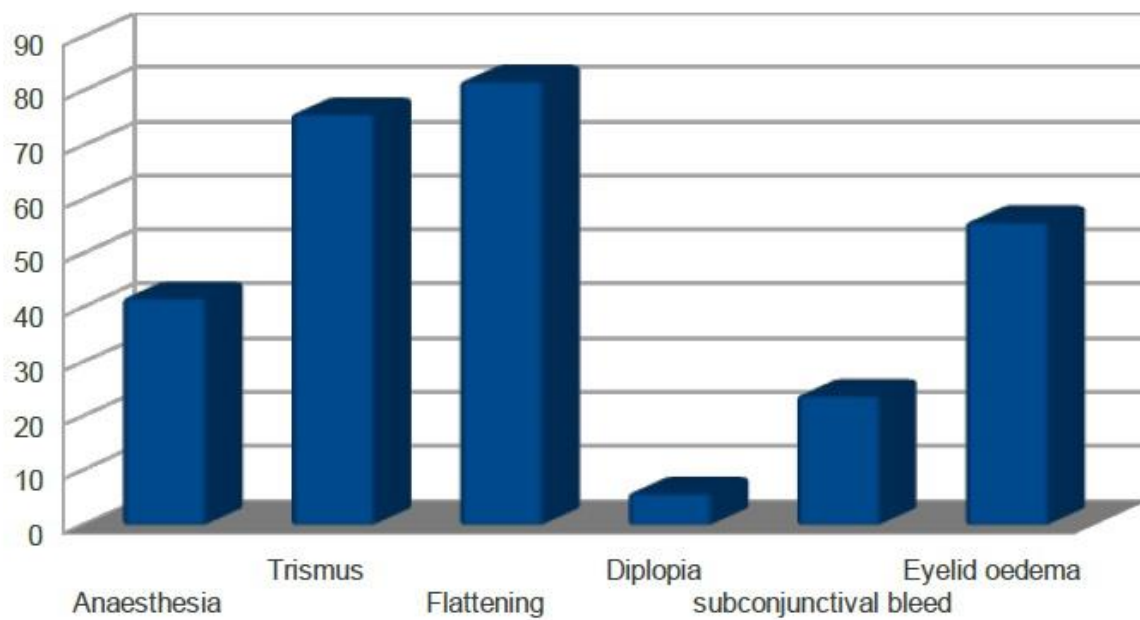


Chart showing the common clinical features our patients presented with

Orbital exploration is indicated in the following circumstances:

1. Severe comminution
2. Displacement of orbital rim
3. Displacement of greater than 50% of the orbital floor with prolapse of orbital contents into the maxillary sinus
4. Orbital floor fracture of greater than 2 cm²
5. Combination of inferior and medial orbital wall fractures
6. Suspected involvement of orbital apex

Our patients commonly presented with cosmetic defect of the malar area, followed by trismus.

Isolated zygomatic arch fracture:

This fracture can be managed easily without the necessity of internal fixation / splinting if reduction is performed within the span of 72 hours following injury. Fractures involving zygomatic arch can cause inability of movement of mandible. These fractures can be reduced using Gillie's temporal approach or Dingman's⁹ supraorbital approach. Other approaches include Buccal sulcus approach.

Studies reveal that temporal or supraorbital approaches provided the best results ¹⁰.

Ruler test:

This is a rather useful clinical test to identify patients with fracture of zygoma.

Two rulers are used as shown in the figure below to perform this test. These rulers are placed in front of the ears. Ruler is found to deviate on the side of fracture.



Figure showing ruler test being performed

Gillie's technique of reducing fracture zygoma:

Small incision is made over temporal area superficial temporal artery is avoided.

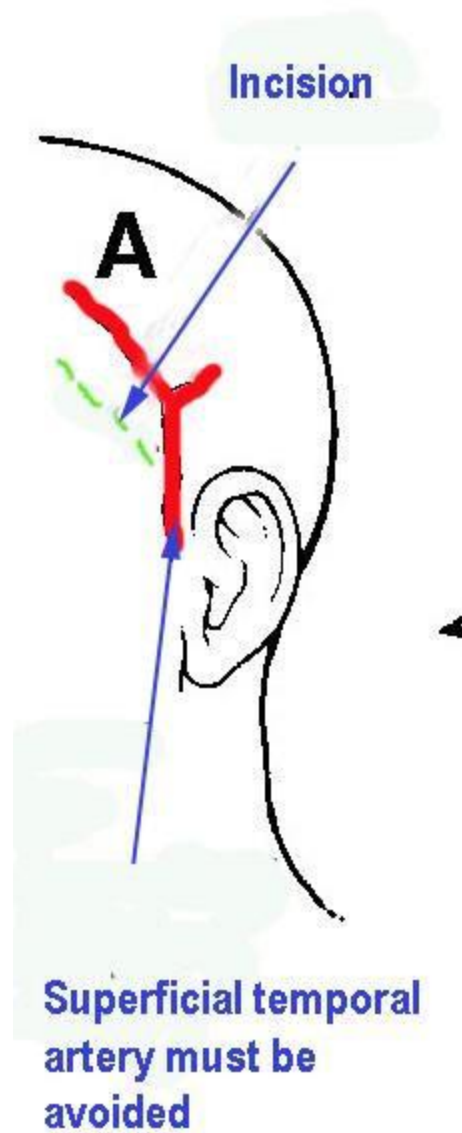
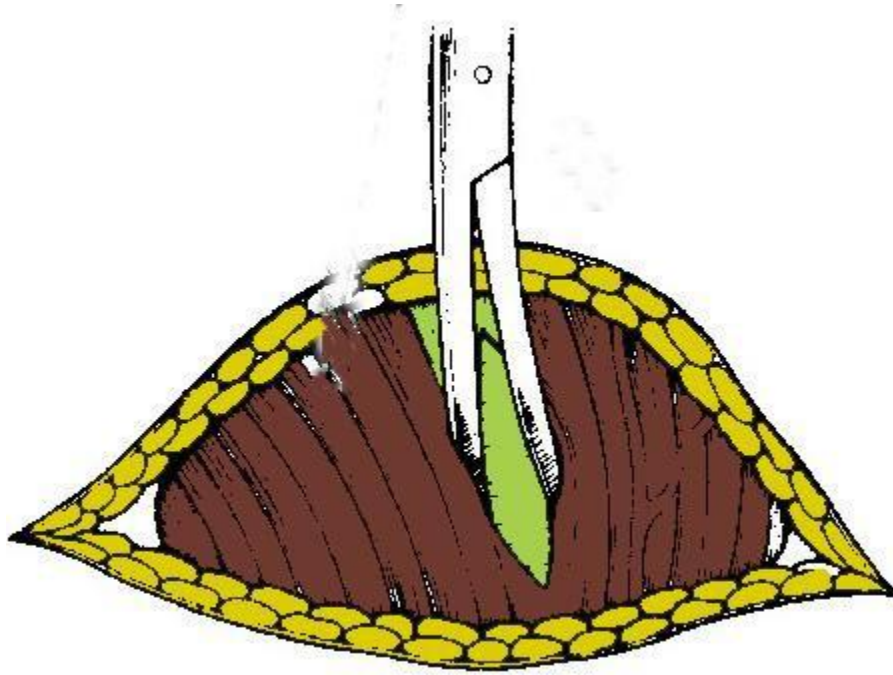


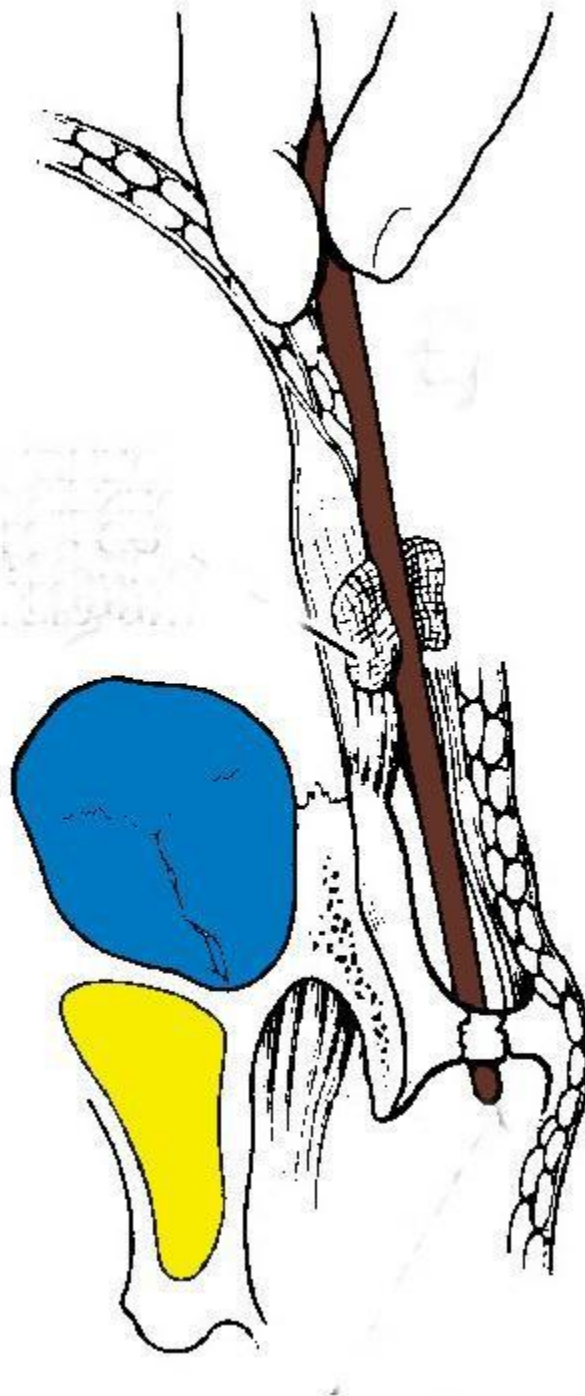
Figure showing incision for Gillies procedure



Auricularis superior muscle is cut along the line of its muscle fibers



Temporalis fascia is cut with a knife



Periosteal elevator is inserted through the incision and the fractured fragment is elevated. A gauze piece is used as a leverage

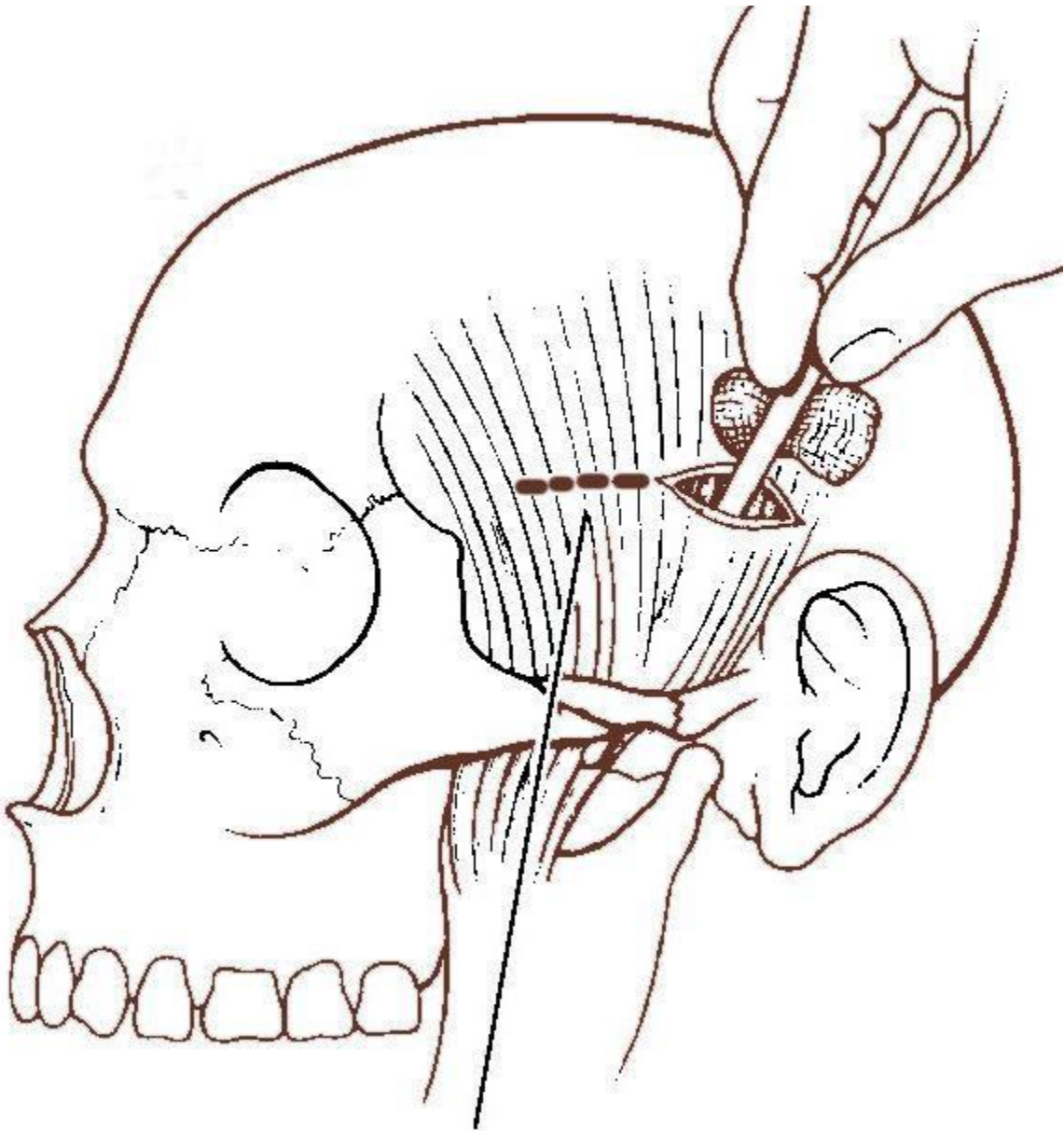


Figure showing fracture arch of zygoma being reduced.

Zygomatic complex fractures:

These fractures are invariably managed by open reduction with two point / three point fixation.

Surgical procedure is performed usually after 4- 6 weeks following injury. If fractures are more than 3 months old then osteotomy will have to be performed. Bone grafts need to be used to perform accurate repair. Usually two point fixation is sufficient in majority of patients. Two point fixation involves microplate fixation at zygomatico-frontal and zygomatic arch areas. When using microplates for zygomatico-frontal area care should be

taken to position it slightly posteriorly so that untoward subcutaneous projection of the plate can be avoided.

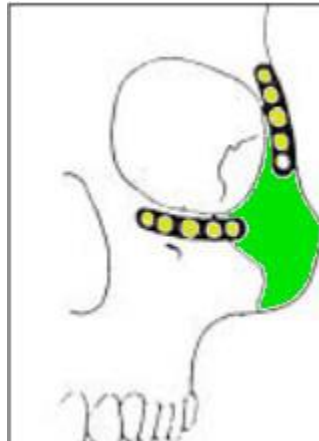


Figure showing two point fixation points

Two point fixation is sufficient in a majority of patients. Rarely when fracture is extensive and associated with lateral displacement of fractured fragments three point fixation need to be resorted to.

Bicoronal approach may be used to approach this area for open reduction purposes. Eye brow incision / transconjunctival incisions can also be used to access this area.



Figure showing three point fixation areas

As shown in the figure three point fixation includes fixing:

1. Frontozygomatic suture
2. Infraorbital rim
3. Zygomatico maxillary buttress

In our analysis only 2 of the 82 patients studied needed two point fixation. All the other patients were managed either conservatively or by closed reduction.

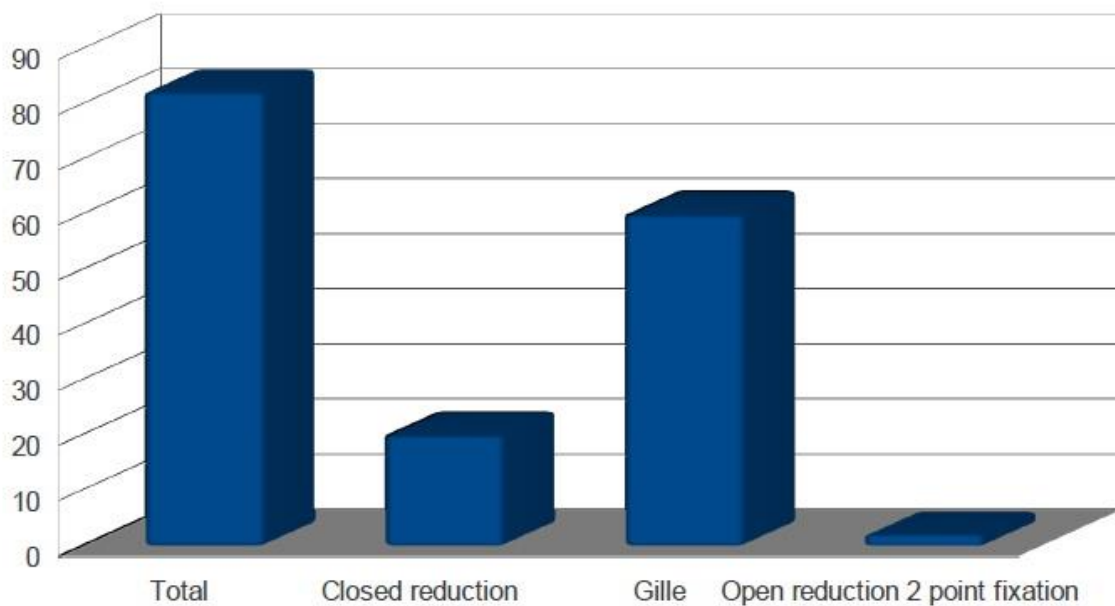


Chart showing the number of patients who underwent various procedures for the management of zygomatic fracture

Classification of zygomatico-maxillary complex fractures:

Zingg's classification ¹¹:

Zingg in 1992 had separated zygomatico-maxillary complex into three types:

1. Type A
2. Type B
3. Type C

Type A :

This type is associated with one component of the tetrapod structure.

This type is subdivided into three subgroups:

Type A1 zygomatic arch alone is fractured.

Type A2 fracture of lateral orbital wall

Type A3 fracture of inferior orbital rim

Type B fracture:

This type of fracture involves all 3 buttresses. Also known as Tripod fracture. This fracture will have to be treated by two point fixation / three point fixation techniques.

Type C fracture:

These are comminuted fractures involving zygoma.

Orbital floor is the weakest component of the zygomatic-maxillary complex. Type A3, B and C are associated with fracture of the floor of orbit with risk of injury to orbital contents.

Conclusion:

This study reveals:

1. Majority of our patients with fracture zygoma presented with flattened malar region. Next common symptom of presentation was trismus.
2. All of our patients except for one with fracture zygoma had stable medial displacement
3. Majority of our patients were managed conservatively / Gillie's procedure.
4. Only two patients needed open reduction with three point fixation

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Blow out fracture A Novel Management Modality

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¹Stanley Medical College ²Meenakshi Medical College

Abstract:

Blow out fracture of orbit involves fracture of orbital floor without fracture of infraorbital rim. This injury is common from frontal blow to orbit. Frontal blow to orbit causes increased intraorbital tension causing fracture of floor of the orbit (weak point) with prolapse of orbital content into the maxillary sinus cavity. This causes enophthalmos and diplopia. Infraorbital rim is not involved in pure blow out fracture, it is also involved then it should be considered as an impure blow out fracture [3]. Entrapment of inferior rectus muscle between the fracture fragments will cause diplopia in these patients. This article discusses a novel endoscopic internal reduction of fractured fragments. Main advantage of endoscopic approach is the lack of facial skin incision. It is cosmetically acceptable.

Introduction:

Orbital floor fractures were first described by MacKenzie in Paris in 1884 [1]. Smith was the first to describe entrapment of inferior rectus between the fracture fragments. He was also the first to coin the term "Blow out fracture" [2]. Blow out fracture causes an increase in the intraorbital volume, this causes enophthalmos. Entrapment of inferior rectus muscle causes diplopia. These patients usually report to an ophthalmologist since orbital signs and symptoms are predominant. Shere et al in their study conclude that nearly 14% of blow out fractures are caused by contact sports in a military population [4].

Case report:

30 years old male patient came with complaints of:

1. Swelling right eye – 1 day duration
2. Double vision – 1 day duration
3. Bleeding from right nose – 1 day duration

History of injury on being struck by a cricket ball +
He gave no history of loss of consciousness.

On examination:

Swelling over upper and lower eyelids on the right side +
Enophthalmos right eye +
Ocular movements restricted on right gaze
Diplopia +
Forced duction test +

CT scan nose and paranasal sinuses:

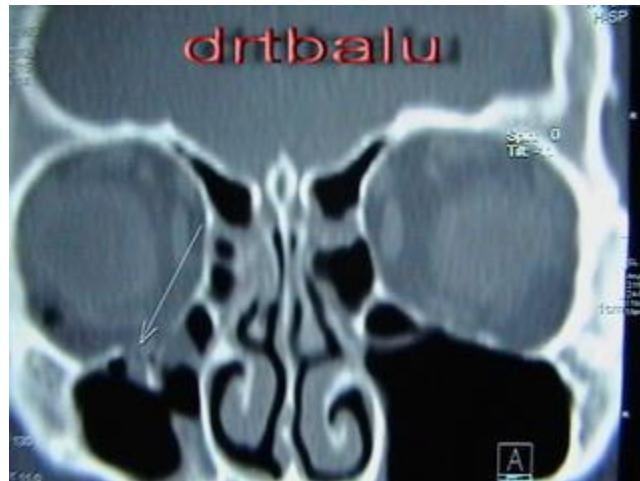
Showed evidence of blow out fracture right orbit. Tear drop sign could be seen.

Management:

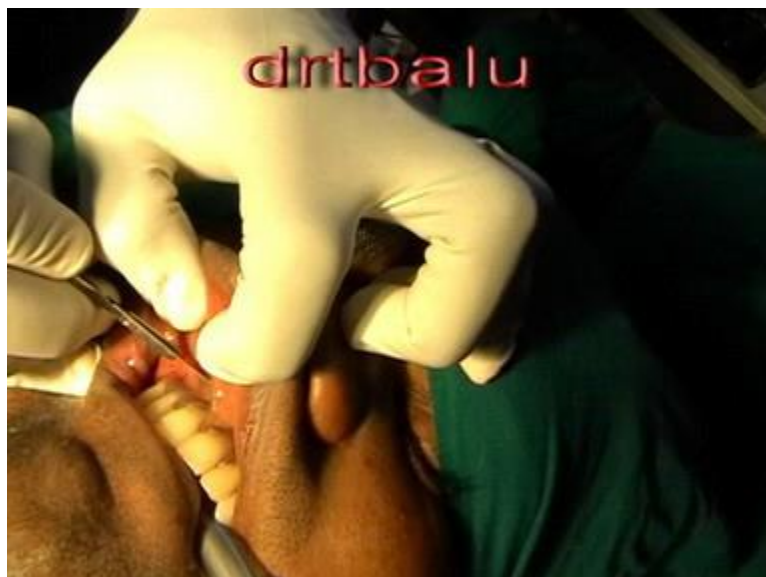
Reduction was performed via Caldwell Luc approach under endoscopic guidance. 4 mm 30 degree nasal endoscope was used for this purpose. Trap door fractures can usually be reduced without resorting to prosthesis. Since this patient had a trap door fracture it could be easily reduced under endoscopic guidance. The reduced fracture fragment was stabilized by inflating the balloon of foley's catheter introduced into the maxillary sinus via inferior meatal antrostomy. Foley's catheter is left in place for a period of 2 weeks for union to occur.



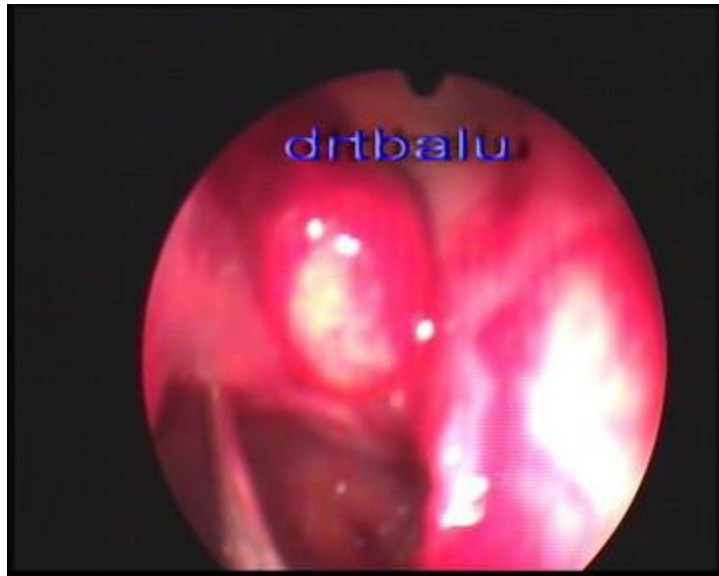
Clinical photograph of a patient with blow out fracture right orbit



CT scan paranasal sinuses showing blow out fracture and the classical tear drop sign



Picture showing sublabial incision for caldwel luc surgery



Blow out fracture is seen being reduced via the opening made over the canine fossa area under endoscopic guidance.



Foley's catheter seen inside the antrum



Balloon of foley's catheter seen inflated inside the antrum

Discussion:

Orbital blow out fracture is commonly caused by blunt trauma to the orbit. This is commonly seen in persons involved in contact sports like boxing, foot ball, rugby etc [5].

Two theories attempt to explain this injury phenomenon:

1. Buckling theory
2. Hydraulic theory

Buckling theory:

This theory proposed that if a force strikes at any part of the orbital rim, these forces gets transferred to the paper thin weak walls of the orbit (i.e. floor and medial wall) via rippling effect causing them to distort and eventually to fracture. This mechanism was first described by Lefort [3].

Hydraulic theory [6]:

This theory was proposed by Pfeiffer in 1943. This theory believes that for blow out fracture to occur the blow should be received by the eye ball and the force should be transmitted to the walls of the orbit via hydraulic effect. So according to this theory for blow out fracture to occur the eye ball should sustain direct blow pushing it into the orbit.

Water House [7] in 1999 did a detailed study of these two mechanisms by applying force to the cadaveric orbit. He infact used fresh unfixed cadavers for the investigation. He described two types of fractures:

Type I: A small fracture confined to the floor of the orbit (actually mid medial floor) with herniation of orbital contents in to the maxillary sinus. This fracture was produced when force was applied directly to the globe (Hydraulic theory).

Type II: A large fracture involving the floor and medial wall with herniation of orbital contents.

This type of fracture was caused by force applied to the orbital rim (Buckling theory).

Initial signs and symptoms of blow out fracture include:

1. Immediate swelling of the eye
2. Tenderness over involved orbit
3. Pain and difficulty with eye movements
4. Double vision
5. Enophthalmos
6. Numbness / tingling over lower eyelid, nose, and upper lip [8]

Complications of blow out fracture:

1. Herniation of orbital fat into maxillary sinus [9]
2. Orbital emphysema [10]
3. Bleeding into maxillary sinus
4. Entrapment / rupture of ocular muscles
5. Ischaemic muscle contractures [11]
6. Cellulitis
7. Diplopia

Timing for surgical intervention:

This is highly controversial. Some of the authors prefer a waiting period of at least 2 weeks for the oedema to resolve before proceeding with surgical reduction of the fracture. Early intervention is indicated only in white eyed blow out fracture which is common in children. In children the bones are flexible and does not break easily but bends. Significant amounts of orbital tissue may get entrapped in between the fractured fragments causing a compromise in their blood supply. This condition is known as the white eyed blow out fracture. These patients should undergo immediate reduction. Surgery is indicated if the eye has recessed by more than 2 mm into the orbit, ocular movements restricted, persistence of diplopia.

Advantages of endoscopic approach: [12]

1. Accurate fracture visualization
2. Incisions are small
3. Facial incisions can be avoided
4. Minimal soft tissue dissection
5. Hospital stay minimized
6. Cosmetically acceptable

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'old foley's in a new bottle'- USE OF FOLEY'S CATHETER IN ANTERIOR MAXILLARY WALL FRACTURES

Vrinda B Nair Seethalakshmi Narashiman Srikamakshi Kothandaraman

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ABSTRACT

Management of comminuted Zygomaticomaxillary fractures are an entity that has always tested the skill of surgeons. A variety of methods have been coined over the years for management of these fractures. Packing the antrum with a gauze or balloon can be used in much comminuted fractures especially with anterior antral wall communication. Internal immobilization with a Foley's balloon catheter is being used widely in Blow out fractures of orbit and rarely in tripod fractures. Despite a thorough search, not much literature could be found of its use in anterior maxillary wall fractures. The purpose of this article is to appraise this technique in anterior maxillary wall fractures.

INTRODUCTION

The Maxilla acts as a bridge between the cranial base superiorly and the dental occlusal plane inferiorly. It is associated intimately with the oral cavity, nasal cavity, and orbits and this makes the maxilla an important structure both functionally and cosmetically. Fracture of these bones can lead to not only cosmetic disfigurement but can also be life-threatening. Timely and systematic repair of these fractures provides the best chance to correct deformity and prevent unfavourable sequelae.

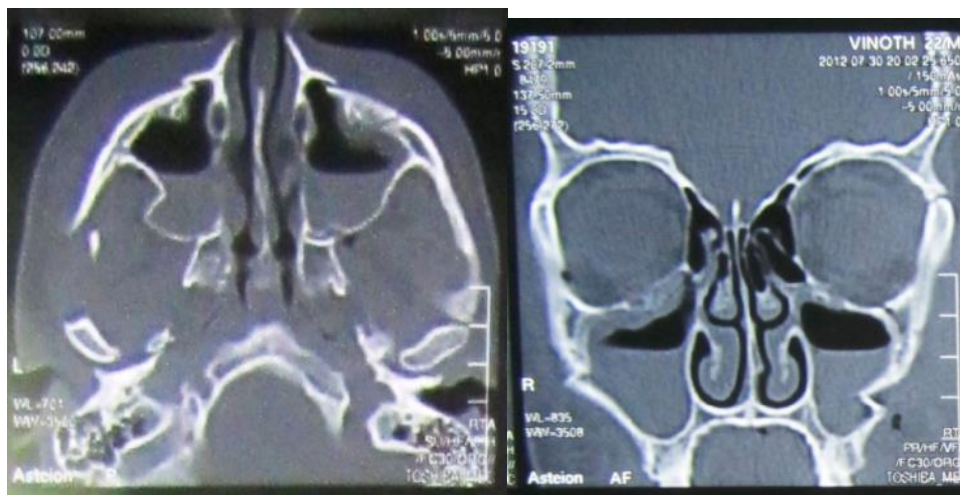
CASE REPORT

A 37 year old male, was admitted in our department as a case of RTA-h/o fall from motor bike, hitting left side of face against side-walk. Following the incident he sustained multiple injuries-lacerated wounds over face, bilateral nasal bleed and deviation of jaw to right side. H/o infraorbital numbness. No h/o loc, seizures, vomiting. CT Facial bones revealed, comminuted depressed fracture –anterior wall of left maxillary sinus with hemosinus. CT Brain was normal.



Another patient, 22 year old male sustained injury to face following a road traffic accident, was admitted with complaints of pain and swelling of both cheeks, and numbness over the left lower lid, side of nose and left half of upper lip. No h/o loss of consciousness, headache or vomiting.

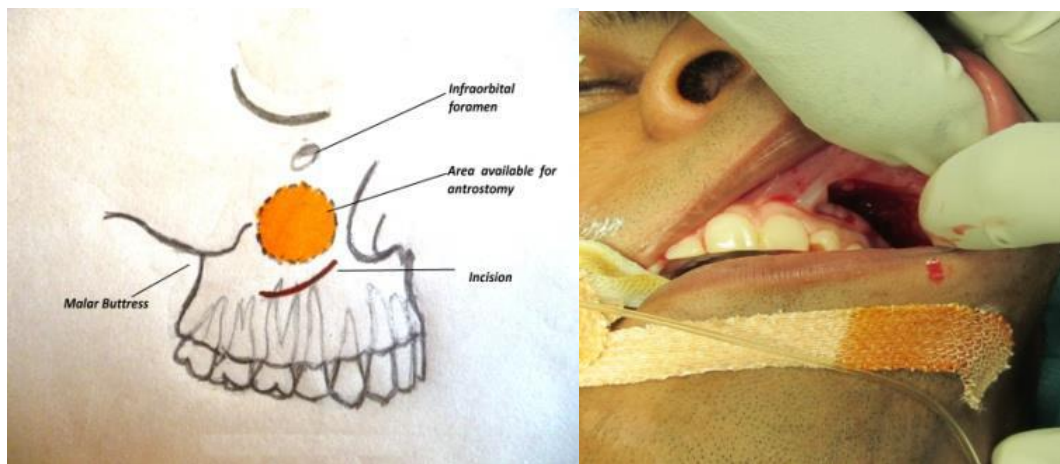
On examination he had tenderness over both maxillary sinus, and reduced sensation over left infraorbital nerve distribution.



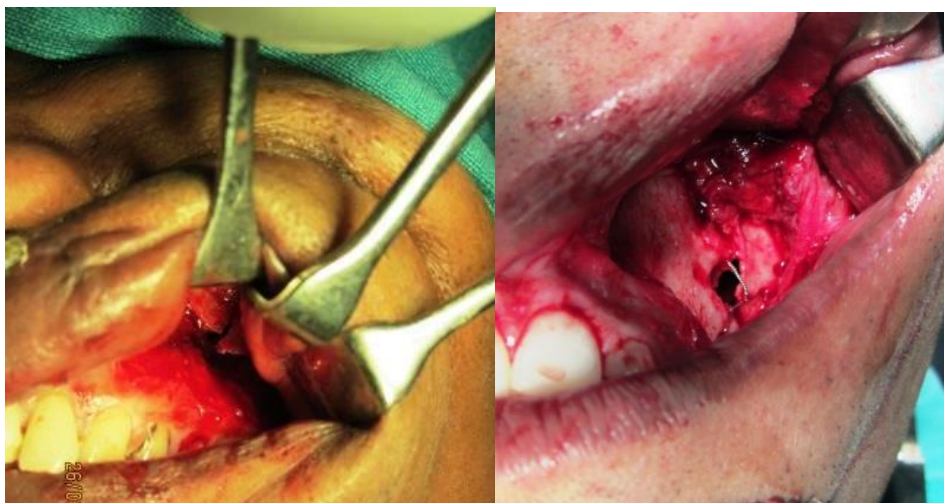
CT Facial bones revealed, comminuted depressed fracture –anterior wall of left maxillary sinus, and a minimally displaced anterior maxillary wall fracture over the right side with bilateral hemosinus.

CT Brain was normal.

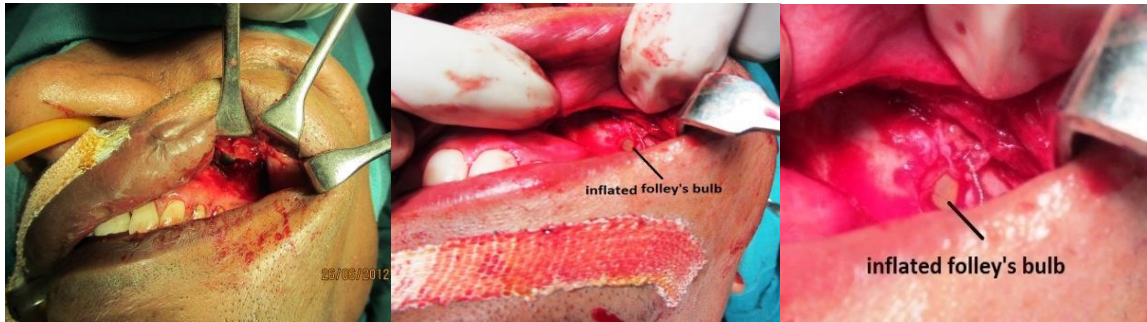
After initial stabilization, and treating with antibiotics and anti-inflammatories, patients were taken up for surgery.



With patient in supine position, head turned 200 to right side, infiltration was given in left sublabial and gingivolabial sulcus. Incision made in left gingivobuccal sulcus. Periosteum was elevated over anterior wall of maxilla. Fractured fragments seen dislodged from anterior wall of maxilla was repositioned with metal wire.



Inferior meatal antrostomy was done, No.16 Foley's catheter introduced through it and inflated with AIR until fracture segments were aligned.



The same was sutured with the nose. Flaps were repositioned and periosteum sutured with 2-0 vicryl.



On day 8, patient was discharged with the foley's catheter in situ. The same was removed on day 15.



Clinical photograph of patient post op

DISCUSSION

Faciomaxillary trauma and upper airway injuries are very common and pose problems in airway management. There may be associated injuries to the cranial fossae and brain, cervical spine, skeleton and chest. Hence a multidisciplinary management involving otolaryngologists, oral surgeons and dentists, plastic surgeons, ophthalmologists, neurosurgeons, anaesthetists and trauma surgeons is what is to be coordinated and followed rather than fragmented care.[12]

SIGNS & SYMPTOMS^[14]

FRACTURES	SIGNS & SYMPTOMS				
	V2 Deficit	Diplopia	Deformity	Trismus	Malocclusion
Ant. Maxillary Wall	+				
Orbital Floor	+	+			
Zygomaxillary Complex	+	+	+	+	
Nasomaxillary Complex	+	+	+		
Zygomatic Arch			+	+	
Entire Unilateral Maxilla	+	+	+	+	+

Mechanisms of Injury[12]

Faciomaxillary and upper airway injuries are due to sharp or blunt injuries to the head or neck. Sharp injuries usually result in lacerations and penetrating injuries, whereas blunt injuries result in fractures to the facial skeleton. Over 50% of facial trauma are the result of motor vehicle accidents. Rest are due to physical violence, sports injuries, falls and work-related accidents. The severity of facial fractures are directly related to the degree of force applied and the velocity of injury. Over 50% of severe Faciomaxillary injury are accompanied by other associated injuries.

CLASSIFICATION OF MIDDLE THIRD FRACTURES

Broadly classified as

A) **Le fort** I ,II ,III

B) **Erich's** in 1942 , as per the direction of fracture line- **Horizontal** , **Pyramidal** ,**Transverse**.

C) Depending on the relation of fracture to zygomatic bone – **Subzygomatic** , **Suprazygomatic**.

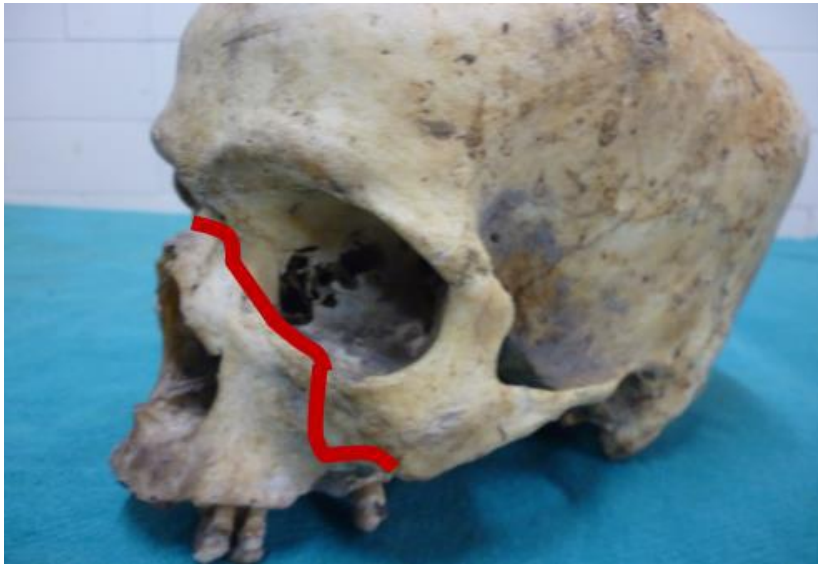
D) Depending on the level of fracture – **Low level** , **Mid level** ,**High level**.

Le fort classification of Maxillary Fractures [1] [12]

René Le Fort described a classification of maxillary fractures in 1901 which is still used today, although fractures are usually of mixed types. Three predominant types were described.

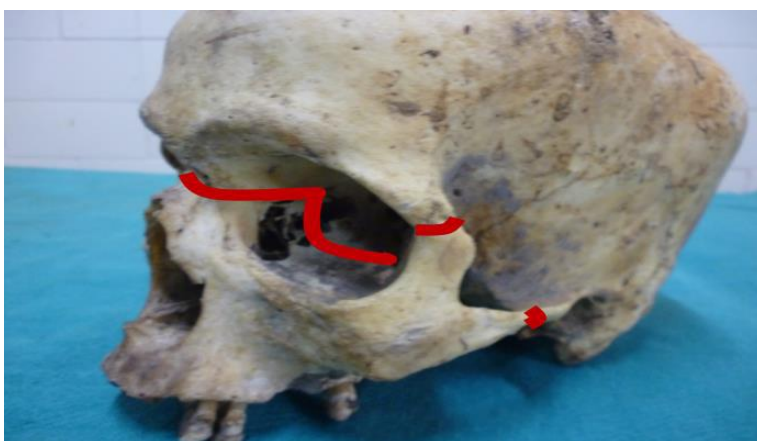


Le Fort I fractures (horizontal) also known as **Guerin's fracture /floating fractures** may result from a force of injury directed low on the maxillary alveolar rim in a downward direction. It separates the palate from the remainder of the facial skeleton. The fracture extends from the nasal septum to the lateral pyriform rims, travels horizontally above the teeth apices, crosses below the zygomaticomaxillary junction, and traverses the pterygomaxillary junction to interrupt the pterygoid plates.



Le Fort II fractures (pyramidal/Subzygomatic fractures) may result from a blow to the lower or mid maxilla. Such a fracture has a pyramidal shape and extends from the nasal bridge at or below the nasofrontal suture through the frontal processes of the maxilla, inferolaterally through the lacrimal bones and inferior orbital floor and rim through or near the inferior orbital foramen, and inferiorly through the anterior wall of the maxillary sinus; it then travels under the zygoma, across the pterygomaxillary fissure, and through the pterygoid plates.

Le Fort III fractures (transverse/Suprazygomatic fracture), also termed **Craniofacial Dysjunctions/"Dish-Face" deformity**, and may follow impact to the nasal bridge or upper maxilla; usually as a consequence of superiorly-directed blows to the nasal bones.



These fractures start at the nasofrontal and frontomaxillary sutures and extend posteriorly along the medial wall of the orbit through the nasolacrimal groove and ethmoid bones. The thicker sphenoid bone posteriorly usually prevents continuation of the fracture into the optic canal. Instead, the fracture continues along the floor of the orbit along the inferior orbital fissure and continues superolaterally through the lateral orbital wall, through the

zygomaticofrontal junction and the zygomatic arch. Intranasally, a branch of the fracture extends through the base of the perpendicular plate of the ethmoid, through the vomer, and through the interface of the pterygoid plates to the base of the sphenoid. As it involves the ethmoid bone, it may affect the cribriform plate at the base of the skull.

Despite the LeFort classification, maxillary fractures may often be a mixed variety. Similarly, facial fractures may be comminuted and may not be symmetrically distributed.

Nevertheless, comminuted fractures usually follow the LeFort fracture lines. LeFort II and III fractures involve the orbit and are frequently associated with orbital blowout fractures through which ocular muscles may herniate.

Acute Management [12]

The major concern during acute management of Faciomaxillary and neck injuries is airway patency. Once that has been managed, other life-threatening injuries and trauma-related major system failure may be addressed. Thus, treatment priorities are to clear and secure the airway, control haemorrhage, treat hypovolaemia, and evaluate for associated life-threatening injuries. When these are satisfied, management is directed towards the facial, neck and other injuries.

GENERAL MANAGEMENT [12]

In patients without airway obstruction, a 30° head-up position is preferred so as to encourage drainage of blood, saliva and CSF away from the airway. This also helps in preventing obstruction by the disrupted tissue. Following airway management, maxillary and mandibular fragments can be repositioned and a head wrap applied to maintain stabilization.

The definitive approach towards Faciomaxillary fractures can be planned after a "*grace period*" of up to 10 days taking into account patient comfort. But in orbital injuries when ocular function is at risk, an early surgery is mandatory. When gross facial swelling occurs, definitive surgery should be delayed and measures like wound debridement, removal of foreign bodies, closure of facial lacerations, ice packs, and head-up nursing to reduce venous pressure and encourage fluid resorption should be instituted. Prophylactic antibiotics should be used in those with CSF rhinorrhoea, compound wounds and when operative fixation of fractures is performed.

RADIOLOGICAL EVALUATION

Once the patient is fully stabilized, radiologic evaluation should commence.

When using Plain films, the following radiographs should be taken –

- 1) Lateral skull view
- 2) Water's view
- 3) PA & AP views of skull
- 4) OPG
- 5) Towne's view- zygomatic arches, vertical rami of mandible.
- 6) Occlusal radiograph for split palate.

Preferred Radiologic Modality: CT scan.

DEFINITIVE MANAGEMENT

Goals of treatment –

- 1) Precise anatomical reduction to cranial base above and to the mandible below.
- 2) Stable fixation of reduced fragments
- 3) Preservation of blood supply to fractured site.
- 4) Restoration of function.

REDUCTION OF MAXILLA

1. Manual reduction.
2. Reduction with wires.
3. Reduction using disimpaction forceps.
4. Reduction by means of traction(elastics)

Closed reduction can be done in

- 1) Non displaced fracture
- 2) Grossly comminuted fractures
- 3) Fractures exposed by significant loss of overlying soft tissues.
- 4) Edentulous maxillary fractures
- 5) In children with developing dentition.

Open reduction to be done in

- 1) Displaced fractures
- 2) Multiple fractures of facial bones
- 3) Fractures of edentulous maxilla with severe displacement.
- 4) Edentulous maxillary fracture opposing an edentulous mandibular fracture.
- 5) Delay of treatment and interposition of soft tissues between non-contacting displaced fracture segments.
- 6) Specific systemic conditions contraindicating IMF.

Surgical Approaches [13]

Multiple approaches are often required to achieve the necessary exposure in cases where open reduction is required. Common routes for Faciomaxillary fractures viz. *Labiobuccal, Gillies, and lateral brow incisions, Coronal & Hemicoronal, Midfacial Degloving, Transconjunctival/Subciliary* will not be discussed here.

Transantral

This is basically the Caldwell-Luc approach and is easily utilized in cases where there is a defect in the anterior maxillary wall, giving direct access to the orbital floor, lateral nasal wall, and inner aspects of the zygoma and zygomaticomaxillary buttress. This access can be used prior to repair of the anterior maxillary wall, or the defect can be left unrepaired if it is small. Alternatively, a defect can be created surgically. Through this opening, elevators or other instruments such as urethral sounds (see below) can be used to assist in reduction of fractures. Maxillary sinus packing to support an isolated lateral nasal wall or orbital floor fracture can also be introduced through the opening, with the end of the packing material brought out through the defect or through a nasoantral window.

Nasoantral window

This method of access to the inner surface of the zygoma has been useful in cases where reduction of the zygoma is difficult and there is a desire to avoid additional surgical approaches. It can be utilized in combination with other approaches or alone in cases where closed reduction is planned. The technique requires the creation of a nasoantral window under the inferior turbinate to allow the introduction of a curved urethral sound into the maxillary sinus. The sound is advanced until the blunt tip of it is against the hollow of the interior surface of the zygoma. By applying manual pressure over the zygoma while maintaining pressure on the inner surface of the zygoma with the sound, the zygoma can be fairly easily manipulated bimanually.

Palpation of the fracture lines and or the malar eminence is used to evaluate the reduction. Internal fixation can then be carried out if needed.

ROLE OF FOLEY'S CATHETER [4]

The first Antral balloon was introduced by Anthony(1952), via an intranasal antrostomy. The direct sublabial approach was not used as it was used in fractures with a large orbital floor component, the pressure within the bag being used to both reduce and fixate any bony fragments. Jackson et al in 1956 reported two cases in which the Shea –Anthony Balloon catheter was used in zygomatic fractures again via an intranasal antrostomy. They suggested this technique in conjunction with the Gillies temporal approach (1927), or external traction method. Jarabak (1959) first used the 30cc. Foley's catheter via sublabial transantral route. Fixation of the balloon was done following a manual reduction of the fracture. Gutman et al (1965) modified the Foley's catheter technique by reducing the fracture via the sublabial transantral approach by inserting the catheter through an intranasal antrostomy.

We introduced the foley's bulb into the antrum via an inferior meatal antrostomy and inflated it with AIR so as to prevent complication of aspiration just in case of a bulb rupture. We found an antral Foley's bulb much better than antral packing for internal fracture immobilization.

Unlike antral packs which have to be removed by 48-72 hours, Foley's could be kept insitu even up to 3 weeks without fear of infection. It gave good results in terms of fracture reduction and improvement of infraorbital numbness. Patients found it more comfortable as it didn't give them that 'stuffed' feeling as with antral packing ;neither did they have any annoying foul smelling nasal discharge despite being kept for a longer period. The only thing that worried the patients was the cosmetic disfigurement caused by a long tube sticking out of their nose. But considering its benefits, a small cosmetic trouble for a short span is quite acceptable.

The extended uses of Foley catheter in Plastic Surgery [3]



Image showing Foley's catheter

Following modification of the urinary catheter by a simple addition of an inflatable distal retaining balloon by Dr. Frederick E. B. Foley in 1934, surgeons have been using it widely in many fields of surgery -

- Reduction of orbital, unstable zygomatic arch and corpus fractures.
- Reconstruction of the orbital floor: A Foley catheter was placed into the maxillary sinus to provide temporary support for the lyophilized tensor fascia lata graft.
- Eye socket reconstruction: Foley's catheter has been used for 2 purposes in this situation: to keep the skin bag bulging and to drain the exudates in the skin bag.
- Intraoperative tissue expansion: Tissue gain has been achieved by intraoperative tissue expansion using Foley's catheter. For this aim Foley's catheter has been used for cleft palate repair, eyelid reconstruction and some skin defects.
- Alar stabilization: A technique of intraoperative nasal ala stabilization to aid excision of skin lesions on the nasal ala and the surrounding skin has been described.
- Nostril retainer: A part of silicone urine catheter has been used as a nostril retainer.

- Short-term drainage in frontal sinus surgery: Foley's catheter has been used purpose a short-term drainage and fronto-nasal duct kept patent for several weeks or months of frontal sinus disease.

In addition of these, there should probably be many more unpublished uses of the Foley's catheter in Plastic Surgery.

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Fracture frontal bone and its management

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Abstract:

Fractures involving frontal bone are rather uncommon. Injuries to this bone is rather critical because of its proximity to brain. This article attempts to discuss this topic with focus its prevalence, its causes and various treatment modalities available. Three crucial areas need to be addressed. They include anterior table, posterior table and frontal sinus outflow tract. Posterior table fractures are usually associated with anterior table fractures and CSF leak. Hence these patients should be treated as head injury cases

Introduction:

Fractures involving frontal bone is rather rare because of its protected location ¹. It is basically protected from trauma by the prominence formed by the nasal pyramid. Incidence of fractures involving this area ranges between 5-15% ³. Fractures involving this bone is considered to be rather dangerous because of its proximity to brain as well as due to the cosmetic defects it can produce. The proximity of this bone to the orbit and naso frontal duct doesn't help matters either. Fractures involving this area if not treated promptly can lead to ²:

1. Meningitis
2. Mucopyocele
3. Encephalitis
4. Cerebral abscess

It should be borne in mind that all cases of fractures involving frontal bone should be considered as a potential head injury and should be managed similarly because of its close proximity to the brain.

Causes of frontal sinus injuries:

1. Road traffic accident
2. Assault
3. Industrial accidents
4. Recreational accidents

Classification of frontal bone:

Anterior table fracture

1. with / without displacement
2. with / without outflow tract injury

Posterior table fracture commonly occurs in combination with anterior table fracture

1. with / without displacement
2. with / without dural injury / CSF leak
3. with / without outflow tract injury

Displacement is considered to be present if it is about the width of one table of the frontal bone.

Anatomy of frontal sinus:

Among the para nasal sinuses this sinus shows the maximum variations. In fact variations are so immense that it can safely be stated that frontal sinuses are unique in each and every individual. It may be absent in 5 % of individuals. It is more or less shaped like a L. Drainage channel of frontal sinus is highly variable.

Posterior wall: corresponds to the anterior wall of the anterior cranial fossa.

Floor: is formed by the upper part of the orbits. Frontal sinus appear very late in life. In fact they are not seen in skull films before the age of 6.

The sinus drains into the anterior part of the middle meatus through the fronto nasal duct.

Frontal outflow tract shows conglomeratization of air cells.

Types of frontal sinus air cells include:

I – Type I frontal cell (a single air cell above agger nasi)

II – Type II frontal cell (a series of air cells above agger nasi but below the orbital roof)

III – Type III frontal cell (this cell extends into the frontal sinus but is contiguous with agger nasi cell)

IV – Type IV frontal cell lies completely within the frontal sinus

Materials and methods:

In this study all patients with Faciomaxillary trauma presented at Stanley Medical College Hospital during the 4 year period from 2009 – 2012 were taken.

Inclusion criteria:

All patients with Faciomaxillary injuries.

Exclusion criteria:

Nil

Total number of patients enrolled: 128

All of them had Faciomaxillary injuries.

Number of patients with frontal bone fracture: 12

Total number of patients with Faciomaxillary trauma	Number of patients with frontal bone fracture
128	12

Anterior table fractures – 10
 Posterior table fractures – 2
 All 12 patients were males.

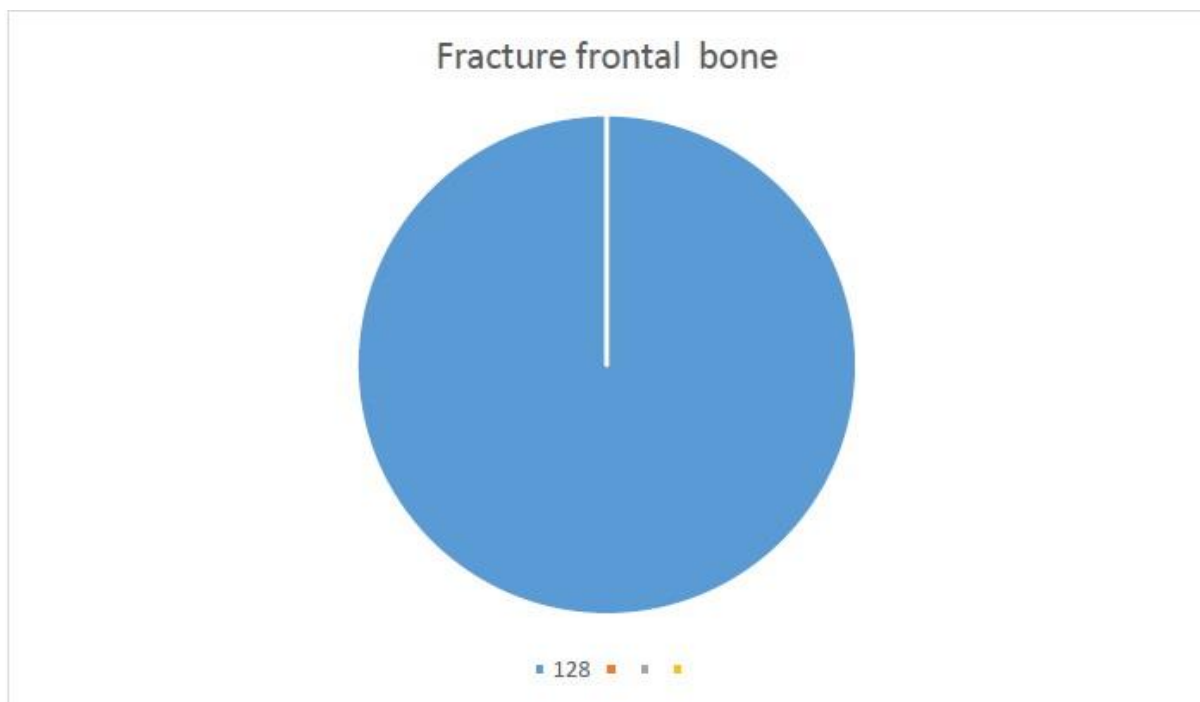


Chart illustrating patients with fracture frontal bone among those with facio maxillary trauma



Clinical photograph of a patient with fracture anterior table of frontal sinus

Common causes of fractures involving frontal bones:

1. Road traffic accident
2. Assault
3. Industrial accidents
4. Recreational accidents

A study of our patients reveal that 8 of them suffered injury due to road traffic accident and 4 patients suffered due to assault.

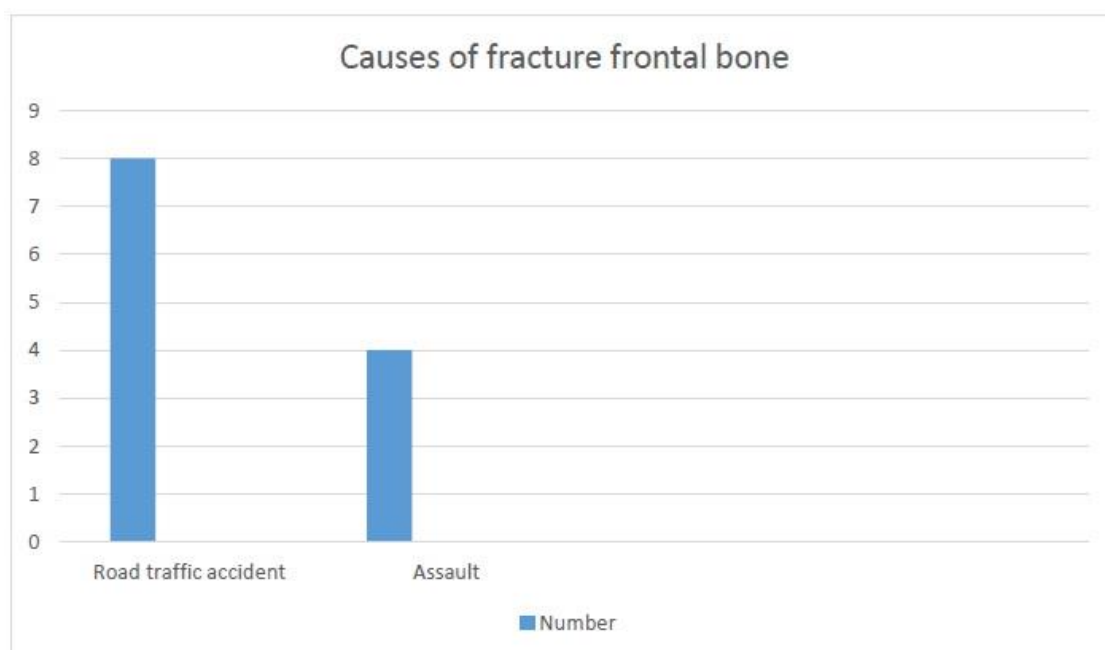


Chart depicting the common causes of fracture frontal bone in our study

Clinical presenting features:

These include:

1. Cosmetic defect
2. Headache
3. CSF leak (in patients with posterior table fractures)

Treatment goals:

1. Protection of intracranial structures
2. Control of CSF leak
3. Prevention of late complications like secondary mucoceles
4. Deformity correction

Assessment of patient with injury to frontal sinus:

1. All suspected patients should undergo a complete ophthalmic examination to rule out injury to the eye.
2. All these patients must undergo CT scan of brain and skull for complete evaluation
3. The patient's consciousness should be monitored carefully to rule out intracranial complications
4. Other associated injuries must be looked for because the force necessary to cause fracture of frontal bone is enormous.

Anterior table fractures:

This is caused by low energy trauma. Commonly this fracture is isolated non displaced fracture. If there is no displacement then observation alone is sufficient.

If it is associated with displacement of fractured fragments then open reduction with internal fixation is the way to proceed.

If there is associated damage to frontal outflow tract then frontal sinus obliteration is advised along with open reduction and internal fixation. Reconstruction of outflow tract is a difficult procedure and is unpredictable. One other way to tackle this problem is observation and medical management followed by endoscopic sinus surgery in future if need arises.

When open reduction with internal fixation is performed care should be taken to avoid entrapment of mucosa within the bone fragments as this would lead to mucocele formation at a later date. Accurate identification of frontal outflow tract injuries are rather difficult to identify in routine CT imaging. Periodical CT scans can be performed to look for evidence of frontal sinus outflow tract obstruction. Frontal trephining can be performed and endoscope can be introduced via the trephine to observe for evidence of outflow tract obstruction.

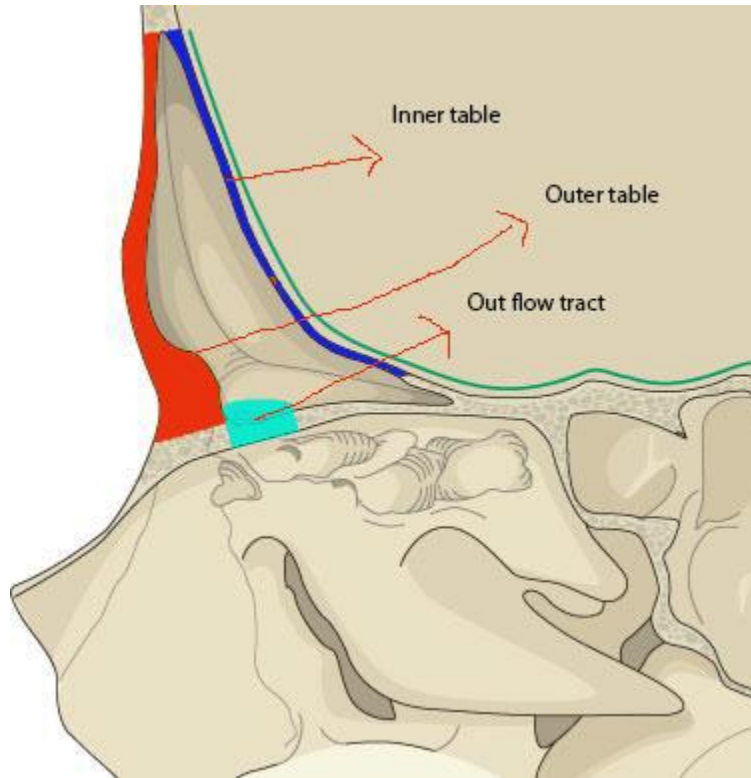


Diagram illustrating various parameters that should be focussed on during the management of frontal bone fractures

Three vital areas that should be addressed while managing fractures of frontal bone:

1. Anterior table
2. Posterior table
3. Frontal sinus outflow tract



Coronal CT scan of nose and sinuses showing fracture involving posterior table of frontal sinus

Management:

Our patients who needed open reduction and internal fixation were managed with

1. Supraciliary approach
2. Bicoronal approach ⁵

Since one of the two patients who needed open reduction and internal fixation had a scar in the supraciliary area the incision was sited in the supraciliary region.



Image showing fractured fragment of outer table being exposed via supraciliary incision

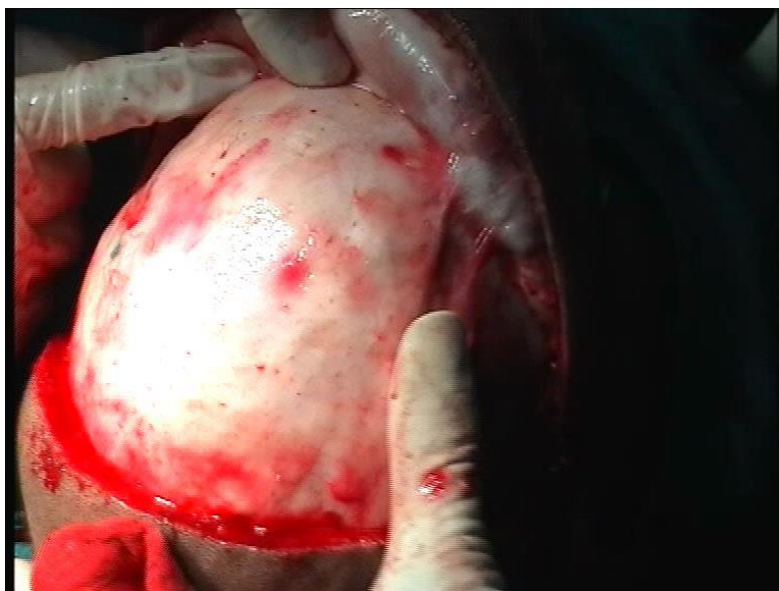


Image showing Bicoronal flap being raised



Image showing frontal sinus being entered via anterior table of frontal sinus

In our series only one patient presented with posterior table fracture with CSF leak. This patient was taken up for open reduction and CSF leak closure via Bicoronal approach. The lone patient who had fracture involving both anterior and posterior tables with frontal outflow tract block had a cannula placed in the frontal sinus under endoscopic guidance and left in place for 4 weeks.

Tips for frontal bone fracture repair:

1. All depressed fractures of more than one table width should be reduced
2. Titanium mini plates are very useful with good success rate
3. In comminuted fractures titanium mesh is ideal

Conclusion:

1. All frontal bone fractures need not be reduced
2. When there is posterior table fracture with CSF leak the patient should be treated as head injury patient
3. Depressed fractures with depression of more than the width of the frontal table alone need to be reduced
4. Frontal sinus outflow tract obstruction needs lot of expertise in management. It is always better to obliterate frontal sinus in these cases.

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